URBAN ECOLOGY AND RESTORATION

"City and Nature"

from *The Granite Garden: Urban Nature and Human Design* (1984)

Anne Whiston Spirn

Editors' Introduction

Although landscape architects and park designers have long sought to bring nature into cities, this need was often ignored by developers and the nascent city planning profession in the nineteenth and twentieth centuries. Engineers and developers filled in or paved over streams, wetlands, and shorelines to make way for urban expansion. Highways or railroad lines cut many cities off from their waterfronts. Hills were leveled and native vegetation removed. Landowners platted lots and built roads without considering the implications for wildlife, native plant species, or human recreation. With the advent of central heating, electric lighting, air-conditioning, long-distance food transport, and huge dams and pipelines bringing water from hundreds of miles away, urban residents became well insulated from nature in all its forms, and even from the limitations of climate and local geography.

To be sure, historically urban elites have at times created parks for the benefit of city residents. Central Park in New York City is one of the most famous examples. Often these bits of urban nature have been designed in a pastoral English landscape tradition or more manicured continental style. In European cities, estates belonging to royalty or the nobility have sometimes been turned into public green spaces, as well as lands once occupied by city walls or defensive fortifications, while city squares, cemeteries, the occasional botanical garden, and the remnant "commons" of former grazing land at the center of many New England towns provided green oases within American metropolises. On the suburban fringe twentieth-century developers at times sought to create garden suburbs emulating English country estates. But these amenities did not fundamentally alter the fact that as cities and suburbs grew, their residents were increasingly living in a manufactured world with very little connection to natural ecosystems.

Only with the environmental revolution of the 1960s did activists and policy-makers come to think more systematically about integrating urban development with the natural world, as well as protecting human beings from some of the worst abuses of urban environments. Efforts to restore damaged natural systems within cities gained speed in the 1980s and 1990s, and new fields such as landscape ecology provided conceptual tools for thinking about how reconstructed ecosystems might function. Communities experimented with watershed planning, citizens groups worked to restore creeks and rivers, and use of native, climate-appropriate species soared within landscape architecture.

One of the classic pieces first calling attention to systematic relationships between nature and cities was Anne Whiston Spirn's book *The Granite Garden* (New York: Basic Books, 1984). While McHarg had focused on the interaction of new suburban or regional development with natural landscapes, Spirn looked at nature within densely built cities themselves. A professor of architecture at the University of Pennsylvania, she analyzed the role of different natural entities such as soil, water, wind, and light within urban landscapes,

and argued that the city should be seen as part of nature, not as something existing outside of it. If nature is welcomed into the city, in her view, a delightful urban environment can be created; if nature is ignored, disaster may result. Michael Hough, a landscape architect at the University of Toronto, took a very similar approach in his books *City Form and Natural Processes: Toward an Urban Vernacular* (New York: Van Nostrand Reinhold, 1984) and *Cities and Natural Process* (New York: Routledge, 1995). As with McHarg's writings, Spirn's eloquent, passionate style inspired many in environmental planning and landscape architecture professions who have since worked out specific ways to implement her philosophy.

Nature pervades the city, forging bonds between the city and the air, earth, water, and living organisms within and around it. In themselves, the forces of nature are neither benign nor hostile to humankind. Acknowledged and harnessed, they represent a powerful resource for shaping a beneficial urban habitat; ignored or subverted, they magnify problems that have plagued cities for centuries, such as floods and landslides, poisoned air and water. Unfortunately, cities have mostly neglected and rarely exploited the natural forces within them.

More is known about urban nature today than ever before; over the past two decades, natural scientists have amassed an impressive body of knowledge about nature in the city. Yet little of this information has been applied directly to molding the form of the city – the shape of its buildings and parks, the course of its roads, and the pattern of the whole. A small fraction of that knowledge has been employed in establishing regulations to improve environmental quality, but these have commonly been perceived as restrictive and punitive, rather than as posing opportunities for new urban forms. Regulations have also proven vulnerable to shifts in public policy, at the mercy of the political concerns of the moment, whereas the physical form of the city endures through generation after generation of politicians.

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The city is a granite garden, composed of many smaller gardens, set in a garden world. Parts of the granite garden are cultivated intensively, but the greater part is unrecognized and neglected. To the idle eye, trees and parks are the sole remnants of nature in the city. But nature in the city is far more than trees and gardens, and weeds in sidewalk cracks and vacant lots. It is the air we breathe, the earth we stand on, the water we drink and excrete, and the organisms with which we share our habitat. Nature in the city is the powerful force that can shake the earth and cause it to slide, heave, or crumple. It is a broad flash of exposed rock strata on a hillside, the overgrown outcrops in an abandoned quarry, the millions of organisms cemented in fossiliferous limestone of a downtown building. It is rain and the rushing sound of underground rivers buried in storm sewers. It is water from a faucet, delivered by pipes from some outlying river or reservoir, then used and washed away into the sewer, returned to the waters of river and sea. Nature in the city is an evening breeze, a corkscrew eddy swirling down the face of a building, the sun and the sky. Nature in the city is dogs and cats, rats in the basement, pigeons on the sidewalks, raccoons in culverts, and falcons crouched on skyscrapers. It is the consequence of a complex interaction between the multiple purposes and activities of human beings and other living creatures and of the natural processes that govern the transfer of energy, the movement of air, the erosion of the earth, and the hydrologic cycle. The city is part of nature.

Nature is a continuum, with wilderness at one pole and the city at the other. The same natural processes operate in the wilderness and in the city. Air, however contaminated, is always a mixture of gasses and suspended particles. Paving and building stone are composed of rock, and they affect heat gain and water runoff just as exposed rock surfaces do anywhere. Plants, whether exotic or native, invariably seek a combination of light, water, and air to survive. The city is neither wholly natural nor wholly contrived. It is not "unnatural" but, rather, a transformation of "wild" nature by humankind to serve its own needs, just as agricultural fields are managed for food production and forests for timber. Scarcely a spot on the earth, however remote, is free from the impact of

human activity. The human needs and the environmental issues that arise from them are thousands of years old, as old as the oldest city, repeated in every generation, in cities on every continent.

The realization that nature is ubiquitous, a whole that embraces the city, has powerful implications for how the city is built and maintained and for the health, safety, and welfare of every resident. Unfortunately, tradition has set the city against nature, and nature against the city. The belief that the city is an entity apart from nature and even antithetical to it has dominated the way in which the city is perceived and continues to affect how it is built. This attitude has aggravated and even created many of the city's environmental problems: poisoned air and water; depleted or irretrievable resources; more frequent and more destructive floods; increased energy demands and higher construction and maintenance costs than existed prior to urbanization; and, in many cities, a pervasive ugliness. Modern urban problems are no different, in essence, from those that plagued ancient cities, except in degree, in the toxicity and persistence of new contaminants, and in the extent of the earth that is now urbanized. As cities grow, these issues have become more pressing. Yet they continue to be treated as isolated phenomena, rather than as related phenomena arising from common human activities, exacerbated by a disregard for the processes of nature. Nature has been seen as a superficial embellishment, as a luxury, rather than as an essential force that permeates the city. Even those who have sought to introduce nature to the city in the form of parks and gardens have frequently viewed the city as something foreign to nature, have seen themselves as bringing a piece of nature to the city.

To seize the opportunities inherent in the city's natural environment, to see beyond short-term costs and benefits, to perceive the consequences of the myriad, seemingly unrelated actions that make up daily city life, and to coordinate thousands of incremental improvements, a fresh attitude to the city and the molding of its form is necessary. The city must be recognized as part of nature and designed accordingly. The city, the suburbs, and the countryside must be viewed as a single, evolving system within nature, as must every individual park and building within that larger whole. The social value of nature must be recognized and its power harnessed, rather than resisted. Nature in the city must be cultivated, like a garden, rather than ignored or subdued.

"Land Development and Endangered Species: Emerging Conflicts"

from *Habitat Conservation Planning* (1994)

Timothy Beatley

Editors' Introduction

Although the science of ecology has been developing since the late nineteenth century, only in the 1970s did a knowledge of the importance of habitat and biodiversity come to be applied to landscapes in and around metropolitan areas. One source of inspiration was the field of landscape ecology, pioneered by Richard Forman and others, which developed a language for describing landscapes in terms of "patches" of habitat, "edge" environments, "corridors" of wildlife movement, and "mosaics" of these features. Also important were new public movements to restrain urban growth, to restore nature within urban areas, and to manage watersheds so as to enhance wildlife habitat and reduce flooding through preservation of natural floodplains.

Timothy Beatley here describes the emergence of concern about biodiversity, as well as the issues behind one of the main strategies to preserve species in or near urban areas: habitat conservation plans. Although controversial because they allow some urban expansion to go forward, these plans have frequently been used since the 1980s in an attempt to balance nature with development, or at least to preserve key elements of natural ecological habitat and function when urbanization cannot be avoided altogether. Beatley is a professor of environmental planning at the University of Virginia. His other writings include *Ethical Land Use: Principles of Policy and Planning* (Baltimore, MD: Johns Hopkins University Press, 1994) and *The Ecology of Place* (Washington, DC: Island Press, 1997).

Public awareness and concern about the extinction of species have undoubtedly increased in recent years. Environmental groups like the World Wildlife Fund and the Audubon Society have been quite successful in elevating concern about the anthropogenic impacts on our great storehouse of flora and fauna. The loss of biological diversity, or "biodiversity," has been added prominently to the list of major environmental problems facing the planet. Even ten years ago the term *biodiversity* would have had little meaning even to many environmentalists or conservationists, and still less to the average person on the street. The writings of such scientists as Paul Erhlich and Edward O. Wilson have done much recently to popularize the concerns about the loss of biodiversity.[1]

Yet citizens and public officials in this country tend to see the biodiversity problem, if they see one at all, as primarily occurring in other countries. Species are facing extinction, in the minds of

many, primarily as a result of tropical deforestation in countries such as Brazil and of illegal poaching in Africa and elsewhere. While these are in fact major threats to global biodiversity, there is sometimes a tendency to de-emphasize threats to biodiversity in this country, or in our own backyards. . . .

It is useful and entirely appropriate to place the US problem in the context of the larger global problem. Globally, species and habitat are threatened by numerous activities, including destroying habitat, over-harvesting/over-exploiting, and invasive species disturbing habitat. In recent years habitat loss has become the primary threat to biodiversity as the extent of human settlements continues to grow.

In many parts of the globe this is clearly the direct result of dramatic rises in population levels and the attendant demands placed on the land to feed and shelter these populations. There has been an incredible rise in the global human population from a little over 1 billion at the turn of the century to around 5.4 billion today. A recent United Nations' report predicts that global population levels may rise as high as 12 billion before stabilizing.[2]

Estimating current rates of global extinction, and predicting future rates, are tenuous at best. There is little certainty about the total number of species on Earth, but estimates put the number between 10 and 30 million. Wilson has estimated that if current rates of deforestation continue, extinction rates may exceed the loss of 17,000 species per year.[3] Others have concluded that as much as 25 per cent of our existing species may become extinct by the beginning of the next century. While the predictions vary there is general agreement that the rates are very high and a large segment of the world biota stock is at risk.[4]

In the United States, the causes of habitat loss are more complex than simple population growth. Clearly population levels have risen substantially here, as well. However, compared with those in other nations around the world, the amounts of land and space per capita are quite large in the United States. The problem, it seems, in recent years has been the inefficient and wasteful nature of our land usage. The dominance of the automobile, the impact of federal subsidies provided for home ownership, major federal investments in a national highway system, and equal neglect of mass transit, among other factors, have led to the sprawling land-intensive patterns of development common in the United States.

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The conflicts between species protection and urban growth and development appear all around us, and virtually in every part of the country. Not surprisingly, conflicts are more frequent where the number of rare and endangered species are greatest and where population and development pressures are most severe. Much of the conflict, then, has focused on high-diversity and high-growth states like California, Texas, and Florida. . . . [But] there is diversity in every state and some degree of development and changes as well – thus, the potential for species/development conflicts.

Furthermore, environmental degradation in this country has gradually whittled away at these biological resources. The number of endangered or threatened species listed on the Endangered Species Act continues to climb and is currently well in excess of 700. As well, thousands of additional species have been classified as candidates for listing and could appear at some point in the future. The trends in biodiversity loss appear to move entirely in one direction – species become listed and remain on the list because they rarely recover sufficiently to be removed from it. Notable exceptions are the American Bald Eagle (in the continental United States) and the American alligator.

These increasing conflicts typically pit environmentalists and supporters of biodiversity conservation against developers and supporters of community development and growth. In addition, there are typically a variety of different stakeholder groups involved in these conflicts and in the preparation of habitat conservation plans, and all have varying perspectives and points of view on the issue, which may or may not fall on this conservation/development continuum.

JUSTIFICATION/RATIONALE FOR PROTECTING ENDANGERED SPECIES

Protection of biodiversity and endangered species often conflicts with demands for housing, economic development, and other social and individual objectives. To many these conflicts suggest that those advocating biodiversity must put forth good reasons

why such societal sacrifices should be made. Why should we be concerned with the loss of biodiversity in the first place?

There are a number of arguments for protecting endangered species, and more broadly, biodiversity, and they range from utilitarian and instrumental views to views which support protection based on the intrinsic value and inherent worth of other forms of life. Before proceeding to a discussion of habitat conservation plans, it will be useful to briefly review these different positions.

Many have argued that species and biodiversity should be protected by humans because they produce, or will produce, numerous direct benefits for human society. These benefits may be medicinal in nature, for example, in that the globe's existing stock of flora and fauna represents an immense and largely untapped pharmaceutical storehouse. A large portion of commercial pharmaceutical products are derived directly from wild plants and animals.[5] These medicinal benefits are illustrated well by recent discoveries of the importance of the yew tree, indigenous to the forests of the northwest United States. The bark of the yew tree has been found to be a highly effective treatment for certain types of cancer. It has been estimated, however, that only 5 per cent of all plant species have been examined for their potential pharmaceutical benefits. . . .

Protecting biodiversity also holds the potential for numerous other economic and commercial benefits, such as the discovery of new disease-resistant crops or crops that may adjust better to changing climatic conditions (e.g., the buffalo gourd, which requires little water). As another example, a plant native to Central Africa (the kenof) is currently thought to be a much cheaper and less environmentally harmful source of pulp and paper fibers than trees.[6]

Perhaps more fundamentally, conservation of biodiversity is essential to protecting the viability of the larger ecosystem upon which all species depend. Endangered and threatened species are important indicators of how healthy and sustainable our planet really is. The loss of the Least Bell's Vireo or other songbirds may have little direct impact on people, yet may be indicative of the occurrence of broader environmental degradation as well as being a harbinger of more severe environmental calamities to come.

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Biodiversity is also important in a deeper emotional sense. It seems that humans do value the existence and qualities of other forms of life as is seen in the names of automobiles and other product lines, the images in advertising and business affairs, and the animal symbols representing important societal and governmental institutions. The loss of each species diminishes our lives in important ways. The prospect of an increasingly empty planet in terms of the number and diversity of species is a depressing one. Species extinction represents innumerable lost opportunities for human enrichment.

While these arguments are convincing in their own right, is the existence of a species justified only if it holds some instrumental value or benefit to humans? This attitude, many writers and ethicists believe, epitomizes humans' arrogance as a species (what some have called "speciesism") by failing to perceive the intrinsic value of other forms of life.

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CENTRAL POLICY QUESTIONS

For each habitat conservation plan (HCP) experience, there are a number of specific technical and policy questions which must be addressed. One of the more central of these is what the level of habitat protection must or should be. While certain standards are specified by the Endangered Species Act (ESA) and the US Fish and Wildlife Service (USFWS), there are necessarily differences of opinion about what is required. Should only the bare minimum be protected, or should much larger habitats be set aside to ensure species survival? What types of recovery actions are necessary to ensure long-term survival and recovery, and what level of habitat rehabilitation is needed? Despite the desire for clear and definitive scientific answers to these questions, HCPs . . . illustrate the judgmental and speculative responses to many of these important questions.

Questions also arise about the best strategy for maximizing conservation dollars. Must habitat be protected where the destructive pressures are most evident (i.e., areas subject to urban growth) or should conservation efforts be focused in areas where greater amounts of habitat can be protected

for less cost, and where the long-term ecological viability of the habitat is perhaps more secure?

There is as well in the HCP experiences the common tension between protecting the habitat for a single species, and protecting the integrity of larger systems of which that species may be a part. Reminiscent of the debate over the Northern Spotted Owl is the increasing belief that larger ecosystem integrity is more important, and that efforts should be made to protect habitat for multiple species of concern, not just a single species. . . .

The HCP experience also vividly illustrates a common policy dilemma in many other environmental areas – namely the question of who should bear the burden for conservation efforts. Whether it's the loss of logging jobs in the habitat of the Northern Spotted owl, or the diminution of land value under wetlands regulations, distribution of conservation program costs is an important policy question. While each HCP committee has approached it somewhat differently, they all illustrate the ability to put together funding packages which distribute costs over a number of different sources, including development mitigation fees, federal and state conservation funding, and local bond referenda. Determining the precise package is another major topic in HCP deliberations and inevitably the result of a mixture of compromise and political reality.

NOTES

1 For instance, see Edward O. Wilson and Francis M. Peter (eds). 1988. *Biodiversity*. Washington, DC: National Academy Press; Paul Ehrlich and Anne Ehrlich. 1981. *Extinction: The Causes and Consequences of the Disappearance of Species*. New York: Balantine Books.

2 For a discussion of global population trends, see Paul Ehrlich *et al.* 1990. *The Population Explosion*. New York: Simon and Schuster.

3 "The Current State of Biological Diversity." In Wilson and Peter (eds), *Biodiversity*.

4 See Walter V. Reid and Kenton R. Miller. 1989. *Keeping Options Alive: The Scientific Basis for Conserving Biodiversity*. Washington, DC: World Resources Institute.

5 See, e.g., Norman Myers. 1979. *The Sinking Ark: A New Look at the Problem of Disappearing Species*. New York: Pergamon Press.

6 See Jane E. Brody. 1988. Scientists Eye Ancient Plant as Better Source of Pulp for Paper. *New York Times*, 10 December.

"What Is Restoration?"

from *Restoring Streams in Cities* (1998)

Ann L. Riley

Editors' Introduction

The early environmental movement in the late nineteenth and early twentieth centuries focused on "conservation" or "preservation" of natural lands, resources, and species. In contrast, many urban environmental groups after about 1980 came to focus on restoring previously damaged urban ecosystems. "Restoration" has thus become a catchword of the urban sustainability agenda. Restoration activities may take many forms, but often focus on cleaning up contaminated lands (often known as "brownfield" sites), replanting native vegetation, and restoring streams, wetlands, or other watershed elements.

In this selection, stream restoration pioneer Ann L. Riley discusses some main issues surrounding urban environmental restoration, especially in the context of waterways. She describes what restoration is and what it is not, and gives examples in the context of creek restoration, a movement particularly active in the western United States. Examples include San Luis Creek through the center of San Luis Obispo, California, portions of Strawberry Creek in Berkeley, California, and the Guadalupe River in San Jose. Restoration of native species and habitats is a closely related movement, as is xeriscaping (use of drought-tolerant plants) in arid or semi-arid cities and towns. Other writings on the subject of restoration, use of native species, and permaculture (a philosophy of basing landscape design and "permanent agriculture" on sustainable natural systems) include *Design for Human Ecosystems: Landscape, Land Use, and Natural Resources*, by John Lyle (Washington, DC: Island Press, 1999), *The Ecological City: Preserving and Restoring Urban Biodiversity*, edited by Rutherford H. Platt, Rowan A. Rowntree, and Pamela C. Muick (Amherst, MA: University of Massachusetts Press, 1994), *Sustainable Landscape Construction: A Guide to Green Building Outdoors*, by J. William Thompson and Kim Sorvig (Washington, DC: Island Press, 2000), and *Permaculture: A Practical Guide for a Sustainable Future*, by Bill Mollison (Washington, DC: Island Press, 1990).

The Society for Ecological Restoration defines ecological restoration as "the process of intentionally altering a site to establish a defined indigenous, historical ecosystem. The goal of this process is to emulate the structure, function, diversity, and dynamics of the specified ecosystem."

[Another] interesting definition that adds more of a human and social component is "the process of intentionally compensating for damage by humans to the biodiversity and dynamics of indigenous ecosystems by working with and sustaining natural regenerative processes in ways which lead to the reestablishment of sustainable and healthy relationships between nature and culture."

Using these definitions, the first problem the restorationist needs to address is what historical and indigenous (native to the location) conditions to restore to. In some circumstances it may be most

practical to restore a waterway to its condition during a particular period of history, such as when it became formally integrated into the urban landscape as a 1930s Works Progress Administration (WPA) city park. The restoration project could include, for example, restoration of a creek's native vegetation and historical WPA rock work if the rock does not harm the waterway. Perhaps the history of a waterway from the late 1800s to the present has been as a degraded, polluted industrial channel. You may want to use records or maps from before this era to determine restoration goals.

It may be institutionally or ecologically impossible to restore a waterway to a landscape representing conditions before European settlers transformed the landscape to something else. For example, when we select objectives to restore the Chicago River, we cannot return it to a shallow, far-spreading prairie wetland as it was before its lowlands were dredged by humans for use as a shipping channel. Our options at this point are to use a riverine model to guide restoration attempts for the channel and to encourage, to the extent possible, the return of some of the pre-European-settlement prairie wetland species.

Restoration, particularly in urban settings, can require complicated compromises and trade-offs in establishing objectives based on the natural and human-built history that has shaped current land uses and ecological systems. A good practice is to refer to local experts who know the regional landscape well to see if any remnant natural rivers, streams, waterways, or wetlands can provide a restoration model for your degraded waterway.

Both ecological and human settlement needs will be met if you strive to create a landscape that is more self-sustaining than existing conditions. This means that the waterway is changed so that it is in greater balance. For a river or stream, this balanced condition usually means that it is not *excessively* eroding or depositing sediment. (Erosion and deposition are natural to streams; we intervene only when we establish that excessive conditions exist.) It also means that it has biologically diverse aquatic life and does not experience extremes in temperature, nutrients, algae growth, or other chemical parameters. If the natural physical features of the waterway are returned, it will not need as much intervention to correct for erosion, sedimentation, or pollution problems.

The physical features of rivers and streams include the streamside trees and shrubs, the channel and its width and depth, pools, riffles, and meanders. The river also includes its floodplain and may feature terraces, which are old, abandoned floodplains located above the current ones. These physical "structures" perform functions in the river ecosystem, including the transport of water and of sediment, the storage and conveyance of floodwaters, and the creation of terrestrial plant communities and wildlife habitat and aquatic habitat. Finally, stream dynamics include the transport of sediment; conveyance of water; formation of channels, floodplains, and terraces; and the interrelationships among these features and the land uses and vegetation in the watershed. Restoration attempts to return these structures, functions, and dynamics to the extent that it is possible given the constraints of our modern developed landscape.

Sometimes it helps to define what restoration is *not* as a way to clarify its objectives. Fisheries restoration is *not* a fish hatchery, where fish are raised at great expense in captivity and released or sometimes driven to rivers, streams, or lakes for release. Most rivers or lakes with stocked fish cannot support the life cycle of those fish. Consequently, the fish must continually be restocked. Fisheries restoration is reintroducing to a river, creek, or lake wild genetic stock that can maintain a self-sustaining population of fish that are genetically adapted to surviving in natural conditions. Restoration in that case means re-creating spawning and rearing habitats; removing barriers to migration; and restoring shelter, favorable temperatures, and water quality for the species that evolved in those conditions and therefore will survive in them on their own.

Restoration is *not* landscaping. Landscaping at its best has been a means to create new environments that provide sanctuary, adventure, symbolism, recreation, environment, and perhaps sustenance. Landscaping is also done to mitigate for a land-use change such as the building of a freeway; the construction of offices, parking lots, and housing developments; and the construction of water projects. Landscape professionals often use planting designs to screen structures, compensating for noise or lost shade or to cover up what we do not want to see. While those are all legitimate

undertakings, they are not restoration. Stream restoration is also not the creation of a "native garden" with water running through it.

Planting trees and shrubs along a stream channelization project is *not* restoration – *even* if native species of plants are used. Planting that is done as an add-on to a flood-control channel, or to try to mitigate some of the lost values of the original river for wildlife or aesthetics, but does not function as a part of a natural riparian system, is landscaping. In such cases, we have not restored; we have only tried to mitigate or compensate for the project's environmental damages. However, if the vegetation functions as a component of a stream environment – if it helps slow the velocity of the water, strengthen stream banks, create vortexes to scour pools, shade the channel to prevent invasion of choking rushes and reeds, or re-create habitat for the species of birds, fish, and mammals that once used the site – then it *is* restoration.

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Restoration can be knowing when not to act. Nature is resilient and often adjusts to changes in the watershed. A critical part of a restorationist's role is to know when to allow nature to make adjustments on its own. A variety of human changes might destabilize a stream, including the building of a dam, regulation of stream flows, diversion of water, urban development, fires or timber harvest, culverting, and channel relocation. Natural disasters, such as floods, tornadoes, earthquakes, and hurricanes, may also destabilize the stream's equilibrium. The stream will react to those changes, and its natural adjustments may or may not have unwanted consequences. A restorationist can give local residents insight into the merits and costs of intervention. In many situations, a stream will find a new equilibrium without intervention. In other situations, a stream will defy attempts to manipulate it by blowing out, eroding, or bypassing carefully designed bank protection projects. Sometimes native plant species will return naturally, coming back more quickly and vigorously as volunteers than we can replant them. The uncertainty of these natural changes underscores the importance of consulting with local geomorphologists, hydrologists, and other professionals knowledgable about local stream dynamics. There is a significant history of misdirected and make-work projects on streams that may do more harm than good to the correction of imbalances in channels and watersheds.

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We are entering a new era of government engineering programs in which public works projects are going to be designed to accommodate a wider range of values and objectives. The concept of multiobjective floodplain management has gained wide acceptance in the past decade in the river engineering and management professions. This concept states that it is of greatest community benefit to manage river floodplains and flood-prone areas for a range of objectives including flood-damage reduction, protection of wildlife habitat, protection or improvement of water quality, ecological restoration, erosion control, provision of recreation, etc. This contrasts with the many older, single-objective public works projects for flood or erosion control.

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Innovations are now being tried in the design of flood-control projects to avoid environmental impacts and performance and maintenance problems. River meanders are being kept, and floodplains are being restored to both better store and better convey large volumes of water. Revegetation systems . . . are replacing concrete, riprap, and sheet piling on stream banks, waterfronts, and lakesides. Restoration methods are providing an exciting alternative to old methods because they can often solve the important engineering problems of lowering property damages *and* provide environmental benefits. They attempt to return to the stream its structure (riparian forests, meanders, pools, riffles, and other physical features), its functions (instream habitat, flood storage, environmental balance, wildlife habitat), and its dynamics (which determine its shape, dimensions, and meander). By doing this, restoration can reduce excessive erosion, return fish habitat, help the stream recover from pollution, and even reduce flood damages. It becomes a win–win solution.